Knittel, Janette

From: Knittel, Janette
Sent: Thursday, April 01, 2021 1:47 PM
To: Tasya Gray
Subject: RE: Former Rhone Poulenc Pre-Sampling Monitoring Well Redevelopment
Attachments: Well Development Guidelines 1992_OCR.pdf; EPA ERT Well Development wmsr2044.pdf

Categories: FOIA, Rhone-Poulenc, Print or Save

Hi Tasya. We have no questions or concerns, EPA approves your redevelopment plan. René had the suggestion to send you the attached guidance documents. He says he prefers the 1992 document because it tends to discuss criteria for development and time to wait after development. He said that overall your proposed approach is close or similar. But now you have these if you need a reference to add to your plan unless you already have an SOP to include in the plan.

Regards,
Janette

Janette Knittel
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From: Tasya Gray <ngray@dofnw.com>
Sent: Saturday, March 27, 2021 10:57 AM
To: Knittel, Janette <Knittel.Janette@epa.gov>
Subject: Former Rhone Poulenc Pre-Sampling Monitoring Well Redevelopment

Hi Janette,
The work plan is in client review, we will turn it around to you as soon as possible this week.

Based on the well inspections performed this month on wells being considered for sampling we are proposing to redevelop seven monitoring wells prior to implementation of the Pre-CMS Data Collection Work Plan. The wells were selected for redevelopment following:

- Field assessment of total well depths to evaluate sedimentation.
- Review of recent sampling forms, when available, to evaluate if significant decreases in purge rates or water level drawdown occurred.

The following wells were selected for redevelopment based on sedimentation (none were identified based on purge rate or water level drawdown issues). We paid particular attention to wells considered for PCB sampling and concerns around turbidity for that.

1. B6
2. MW-22
3. MW-38R
4. MW-40
5. DM-4
6. MW-46
7. MW-39

Our general approach to redevelopment of the monitoring wells will include the following tasks:

- Removal of the pump from the well (if present).
- Measurement of the static water level and calculate well volume including the sand pack.
- Lowering a surge block into the well and vigorously moving the surge block up and down in the well creating a surging action across the screened interval to bring the finer grained materials into suspension.
- Removing the surge block and beginning to purge the well at a sufficient rate to remove fines. Initiating physical water quality testing for turbidity at a minimum frequency of every 1/5th the well volume removed.
- Repeating surging and purging process and monitoring turbidity declines.
- Measuring the total depth of the well after development.
- Transferring purge water to the GWPT building for processing through the treatment system.
- Closing the well appropriately and recording any well integrity concerns in the field book.

DOF is prepared to perform redevelopment work the week of April 5, 2021 if EPA concurs with the scope and plan provided above. Let me know if you would like to discuss further.
Thanks,
Tasya

Tasya Gray, LG

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MONITOR WELL DEVELOPMENT

CONTENTS

*These sections affected by Revision 0.1.

SUPERCEDES: SOP #2044; Revision 0.0; 2/18/00; U.S. EPA Contract 68-C99-223.

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide an overview of monitor well development practices. The purpose of monitor well development is to ensure removal of fine grained sediments (fines) from the vicinity of the well screen. This allows the water to flow freely from the formation into the well, and also reduces the turbidity of the water during sampling. The most common well development methods are: surging, jetting, overpumping, and bailing.

Surging involves raising and lowering a surge block or surge plunger inside the well. The resulting surging motion forces water into the formation and loosens sediment, pulled from the formation into the well. Occasionally, sediments must be removed from the well with a sand bailer to prevent sand locking of the surge block. This method may cause the sand pack around the screen to be displaced to a degree that damages its value as a filtering medium. Channels or voids may form near the screen if the filter pack sloughs away during surging (Keel and Boating, 1987).

Surging with compressed air is done by injecting a sudden charge of compressed air into the well with an air line so that water is forced through the well screen. The air is then turned off so that the water column falls back into the well and the process is repeated. Periodically, the air line is pulled up into a pipe string (educator) and water is pumped from the well using air as the lifting medium (air-lift pumping). The process is repeated until the well is sediment free. Method variations include leaving the air line in the pipe string at all times or using the well casing as the educator pipe.

Jetting involves lowering a small diameter pipe into the well and injecting a high velocity horizontal stream of water or air through the pipe into the screen openings. This method is especially effective at breaking down filter cakes developed during mud rotary drilling. Simultaneous air-lift pumping is usually used to remove fines.

Overpumping involves pumping at a rate rapid enough to draw the water level in the well as low as possible, and then allowing the well to recharge to the original level. This process is repeated until sediment-free water is produced.

Bailing includes the use of a simple manually operated check-valve bailer to remove water from the well. The bailing method, like other methods, should be repeated until sediment free water is produced. Bailing may be the method of choice in a shallow well or well that recharges slowly.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent on site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with a final report.

Mention of trade names or commercial products does not constitute United States Environmental Protection

Agency (U.S. EPA) endorsement or recommendation for use.

2.0 METHOD SUMMARY

After installation, development of a well should occur as soon as it is practical. It should not occur any sooner than 48 hours after grouting is completed, especially if a vigorous well development method (i.e. surging) is being used. If a less vigorous method (i.e bailing) is used, it may be initiated shortly after installation. The method used for development should not interfere with the setting of the well seal.

Several activities must take place prior to well development. First, open the monitor well, take initial measurements (i.e., head space air monitoring readings, water level, total depth of the well) and record results in the site logbook. Develop the well by the appropriate method to accommodate site conditions and project objectives. Continue until the development water is clear and free of sediments, or until parameters such as pH, temperature, and specific conductivity stabilize. Containerize all purge water from wells with known or suspected contamination. Record final measurements in the site logbook. Decontaminate equipment as appropriate prior to use in the next well.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

This section is not applicable to this SOP.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

The following problems may be associated with well development:

1. Overpumping is not as vigorous as surging and jetting, and is probably the most desirable method for monitor well development. The possibility of disturbing the filter pack is greatest with surging and jetting well development methods.

2. The introduction of external water or air by jetting may alter the hydro chemistry of the aquifer.

3. Surging with air may produce “air locking” in some formations, preventing water from flowing into the well.

4. The use of surge blocks in formations containing clay may cause plugging of the screen.

5. Small (2-inch nominal diameter) submersible pumps that will fit in 2-inch diameter well casing are especially susceptible to clogging if used in well development applications.

6. Chemicals/reagents used during the decontamination of drilling equipment may complicate well development.

5.0 EQUIPMENT/APPARATUS

The type of equipment used for well development is dependent on the diameter of the well and the development method. For example, the diameter of most submersible pumps is too large to fit into a two-inch inner diameter (I.D.) well, and other development methods should be used. Obtaining the highest possible yield is not usually an objective in developing monitor wells and vigorous development is not always necessary. Many monitor wells are constructed in fine-grained formations that would not normally be considered aquifers. Specifications for the drilling contract should include the necessary well development equipment (air compressors, pumps, air lines, surge blocks, generators).

6.0 REAGENTS

The use of chemicals in developing wells that will be used to monitor groundwater quality should be avoided if possible; however, polyphosphates (a dispersing agent), acids, or disinfectants are often used in general well development. Polyphosphates should not be used in thinly bedded sequences of sands and clays. The use of decontamination solutions may also be necessary. If decontamination of equipment is required at a well, refer to Environmental Response Team/Response Engineering and Analytical Contract (ERT/REAC) SOP #2006, *Sampling Equipment Decontamination* and the site specific work plan.

7.0 PROCEDURES

7.1 Preparation

1. Coordinate site access and obtain keys to well locks.

2. Obtain information on each well to be developed (i.e., drilling method, well diameter, well depth, screened interval, anticipated contaminants).

3. Obtain a water level meter, a depth sounder, air monitoring instruments, materials for decontamination, and water quality instrumentation capable of measuring, at a minimum, pH, specific conductivity, temperature, and turbidity. Dissolved oxygen (DO) and salinity are also useful parameters.

4. Assemble containers for temporary storage of water produced during well development. Containers must be structurally sound, compatible with anticipated contaminants, and easy to manage in the field. The use of truck-mounted or roll-off tanks may be necessary in some cases; alternately, a portable water treatment unit (i.e., activated carbon) may be used to decontaminate the purge water.

7.2 Operation

Development should be performed as soon as it is practical after the well is installed, but no sooner than 48 hours after well completion.

1. Assemble necessary equipment on a plastic sheet surrounding the well.

2. Record pertinent information in the site or personal logbook (personnel, time, location ID, etc.).

3. Open monitor well, take air monitor reading at the top of casing and in the breathing zone as appropriate.

4. Measure depth to water and the total depth of the monitor well. Calculate the water column volume of the well (Equation 1, Section 8.0).

5. Begin development and measure the initial pH, temperature, turbidity, and specific conductivity of the water and record in the site logbook. Note the initial color, clarity, and odor of the water.

6. Continue to develop the well and periodically measure the water quality parameters indicated in step 5 (above). Depending on project objectives and available time, development should proceed until these water quality parameters stabilize, or until the water has a turbidity of less than 50 nephelometric turbidity units (NTUs).

7. All water produced by development of contaminated or suspected contaminated wells must be containerized or treated. Each container must be clearly labeled with the location ID, date collected, and sampling contractor. Determination of the appropriate disposal method will be based on the analytical results from each well.

8. No water shall be added to the well to assist development without prior approval by the appropriate U.S. EPA ERT Work Assignment Manager (WAM) and/or appropriate state personnel. In some cases , small amounts of potable water may be added to help develop a poor yielding well. It is essential that at least five times the amount of water injected must be recovered from the well in order to assure that all injected water is removed from the formation.

9. Note the final water quality parameters in the site or personal logbook along with the following data:

    - Well designation (location ID)
    - Date(s) of well installation
    - Date(s) and time of well development

C Static water level before and after development
C Quantity of water removed, and initial and completion time
C Type and capacity of pump or bailer used
C Description of well development techniques

7.3 Post-Operation

1. Decontaminate all equipment;

2. Secure holding tanks or containers of development water;

3. Review analytical results and determine the appropriate water disposal method. Actual disposal of the purge water is generally carried out by the On-Scene Coordinator (OSC).

8.0 CALCULATIONS

To calculate the volume of water in the well, the following equation is used:

Well Volume (V) = $\mathbf{B r^2 h (cf)}$ [Equation 1]

where:

B	=	pi (3.14)
r	=	radius of monitoring well in feet (ft)
h	=	height of the water column in ft. [This may be determined by subtracting the depth to water from the total depth of the well as measured from the same reference point.]
cf	=	conversion factor in gallons per cubic foot (gal/ft^3) = 7.48 gal/ft^3. [In this equation, 7.48 gal/ft^3 is the necessary conversion factor.]

Monitor well diameters are typically 2-, 3-, 4-, or 6-inches. A number of standard conversion factors can be used to simplify the above equation using the diameter of the monitor well. The volume, in gallons per linear foot, for various standard monitor well diameters can be calculated as follows:
where:

V (gal/ft) = $\mathbf{B r^2 (cf)}$ [Equation 2]

B	=	pi
r	=	radius of monitoring well (feet)
cf	=	conversion factor (7.48 gal/ft^3)

For example, a two inch diameter well, the volume per linear foot can be calculated as follows:

$$\textbf{V (gal/ft)} = \mathbf{Br^2\ (cf)} \quad \textbf{[Equation 2]}$$
$$= \mathbf{3.14\ (1/12\ ft)^2\ \ 7.48\ gal/ft^3}$$
$$= \mathbf{0.1631\ gal/ft}$$

NOTE: The diameter must be converted to the radius in feet as follows:

$$\frac{\textbf{Well Diameter (inches)}}{\textbf{12}} \textbf{ x 0.5 = Well Radius (feet)} \qquad \textbf{[Equation 3]}$$

The volume in gallons/feet for the common size monitor wells are as follows:

Well diameter (inches)	2	3	4	6
Volume (gal/ft)	0.1631	0.3670	0.6524	1.4680

If you utilize the volumes for the common size wells above, Equation 1 is modified as follows:
where:

Well volume = (h)(f) **[Equation 4]**

h = height of water column (feet)
f = the volume in gal/ft calculated from Equation 2

9.0 QUALITY ASSURANCE/QUALITY CONTROL

There are no specific quality assurance activities, which apply to the implementation of these procedures. However, the following general quality assurance/quality control (QA/QC) procedures apply:

1. All data must be documented in site and/or personal logbooks.

2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and must be documented.

10.0 DATA VALIDATION

This section is not applicable to this SOP.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, Occupational Safety and Health (OSHA), and corporate health and safety practices.

12.0 REFERENCES

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13.0 APPENDICES

This section is not applicable to this SOP.

United States Environmental Protection Agency
Office of Solid Waste and Emergency Response
April 1992

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EPA Ground Water Forum

MONITORING WELL DEVELOPMENT GUIDELINES FOR SUPERFUND PROJECT MANAGERS

Ruth Izraeli* Doug Yeskis, Mark Collins, Kathy Davies, Bernard Zavala

The Ground Water and Engineering Forums were established by EPA professionals in the ten EPA Regional Offices. The Forums are committed to the identification and resolution of scientific, technical and engineering issues impacting the remediation of Superfund and RCRA sites. The Forums are supported by and advise OSWER's Technical Support Project, which has established Technical Support Centers in laboratories operated by the Office of Research and Development, Office of Radiation Programs, and the Environmental Response Team. The Centers work closely with the Forums in providing state-of-the-science technical assistance to EPA project managers.

This document provides well development guidelines and recommended additional sources of information. It was developed by the Superfund Ground Water Forum and draws upon U.S. Army Corps of Engineers and draft RCRA SW-846 field protocols. Comments from ORD and Regional Superfund hydrogeologists have been incorporated. These guidelines are applicable to the great majority of sites. However, unusual, site-specific circumstances may require alternative approaches. In these instances, the appropriate Regional hydrogeologist should be contacted to establish alternative development protocols.

Introduction

The goal of ground-water sampling is to obtain water samples that best represent natural undisturbed hydrogeological conditions. Adequate well development is critical to minimize the introduction of biases into the sampling effort. Well development is necessary because every drilling method disturbs the geologic materials around the well bore to some extent. Development processes are used to try to ensure proper hydraulic connection between the well and the geologic materials in the vicinity of the well. This is done by stressing the formation around the screen so that mobile, artifact particulates are removed. This process is necessary to obtain a ground water sample which is as similar as possible to *in situ* conditions.

One of the major goals of well development is to produce a well capable of yielding ground-water samples of acceptably low turbidity. Excess turbidity may alter water quality and result in erroneous chemical analysis (particularly for unfiltered metals samples which require acid preservation).

Turbidity in ground-water samples is minimized by well development. Proper well development creates a graded filter pack around the well screen. When pumping is first initiated, natural materials in a wide range of grain sizes are drawn into the well, producing very turbid water. However, as pumping continues, the natural materials are drawn into the filter, producing an effective filter pack through a sorting process. This sorting process begins when the largest particles of natural materials are retained by the filter pack, resulting in a layer of coarse particles against the well screen. With continued development, this process produces progressively finer layers until an effective graded filter is produced, which then minimizes turbidity. Development is also necessary to remove any foreign materials introduced during drilling, such as drilling water and mud.

These guidelines are directed toward the development of relatively permeable (i.e., $K>10^{-6}$ cm/sec) aquifers. However, it is sometimes necessary to screen wells in water-bearing zones containing significant quantities of silt and clay, which would not normally be considered producing aquifers. Low-yielding wells located in marginal aquifers often cannot be developed using standard methods. For a discussion of the construction and development of wells in low-yielding forma-

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tions, see Aller et al. (1989), Gass (1989), and Paul et al. (1988).

Wells constructed in bedrock may require special protocols. For example, wells constructed as open boreholes (cased to monitored zone) generally should not be developed using a surge block due to the potential for damaging the borehole walls. Bedrock wells constructed with screens may be developed in two stages, before and after the screen is installed. Since bedrock wells may require special development protocols other than those described here for wells in unconsolidated aquifers, Regional hydrogeologists should be consulted when designing bedrock well development procedures.

Finally, it is important to note that there are some hydrogeologic environments, such as fine-grained "marginal" aquifers and karst terraines, where excess turbidity may still exist even after optimizing well construction (e.g., filter pack size and thickness, screen size, drilling technique) and development.

Development Methods

The common methods for developing wells are described by Aller et al. (1989) and Driscoll (1986) and include:

- Overpumping
- Backwashing
- Surging
- Bailing
- Jetting
- Airlift pumping
- Air surging

Well development procedures that have the potential to alter ground-water quality should not be used. Therefore, methods which involve adding water or other fluids to the well, or use air to accomplish development, are not recommended. Generally unsuitable methods for monitoring well development include jetting, airlift pumping, and air surging. However, air development techniques may be used if they offer site-specific advantages over other methods, and extreme care is taken to prevent air from contacting the screened interval. Air development techniques must only be implemented by an experienced operator.

Recommended monitoring well development methods include pumping, overpumping, bailing and backwashing, in combination with some form of surging. The most effective combination and timing of these methods must be determined through field testing, or from experience developing wells in similar hydrogeologic regimes.

Movement of ground water into the well in one direction generally results in bridging of the particles, and a means of inducing flow reversal is necessary to break down the bridging and produce a stable filter. Aller et al. (1989) state that one of the most effective and efficient methods to induce flow reversal is through careful use of a properly-constructed surge block. For a more detailed description of proper usage of a surge block and other methods of achieving flow reversal, see Aller et al.

One example of a well development field protocol is described below:

1. Record static water level and total well depth.

2. Set the pump and record pumping rate and turbidity. Pump until turbidity (as measured by a nephelometer) reaches desired level or stabilizes.

3. Discontinue pumping and surge the well.

4. Measure depth to the bottom of the well. If more than 10% of the screen is occluded by sediments, remove excess sediment by bailing.

5. Reset the pump, recording pumping rate and turbidity. Pump until turbidity reaches desired level or stabilizes. If the well has been properly designed, the amount of pumping required to achieve the desired turbidity level will be substantially less than required in the first pumping cycle.

6. Repeat surging and pumping until the well yields water of acceptable turbidity at the beginning of a pumping cycle. A good way to ensure that development is complete is to shut the pump off during the last anticipated pumping cycle, leaving the pump in place, and restart it some time later. The turbidity of the discharge water should remain low.

The pumping rate used during development must be greater than the highest rate expected to be used during subsequent purging and sampling. In fact, recent field experience suggests that extremely low (i.e., 100 to 500 ml/min) purging and sampling pumping rates may significantly reduce the turbidity of ground-water samples (Puls et al., 1990). The pump intake should be placed close to, or within, the well screen interval.

The development techniques listed above are most efficient in wells with screens having the greatest area open to the aquifer. Therefore, continuous slot, or wire wrapped screens are recommended for use in formations where adequate development is expected to be difficult. The additional cost of continuous slot screen is typically more than compensated for by significantly less cost in development time and subsequent well purging times.

Development Criteria

Development should continue until clear, artifact-free, formation water is produced. Water quality parameters such as specific conductance, pH, temperature, and turbidity should be measured during development, and should stabilize before development is stopped. Turbidity measurements are the most critical development criteria. Other parameters should be used to provide supplemental information regarding aquifer conditions, and stabilization of these parameters is indicative of the presence of formation water. If water was added during well construction or development, two to three times the volume of water added must be removed. Finally, the well should be producing visually clear water before development is stopped.

Experience has shown that development may take from less than an hour to several days, depending on the formation, development procedures, and well characteristics or construction. In some marginal aquifers such as glacial tills and interbedded sands and clays, it may not be possible to attain the 5 NTUs turbidity target level used as guidance in RCRA. However, poor well construction practices, failure to emplace an adequate filter pack, poor selection of screen slot size and sand pack materials, as well as inadequate development may result in high turbidity levels. In these situations, the PRP or contractor must demonstrate that the well has been constructed properly and all reasonable efforts have been expended to develop the well. The determination of whether to abandon the well or address the turbidity problem during sampling and analysis should be made by the project manager in consultation with a Regional hydrogeologist.

After development is completed, wells should be allowed to stabilize and re-equilibrate before sampling. The time necessary for stabilization depends on the characteristics of the aquifer and the geochemistry of the parameters to be monitored. Generally, high permeability formations require less time (i.e., several days) than low permeability formations (i.e., several weeks).

Development Documentation

Monitoring well development must be thoroughly documented to verify that foreign materials have been removed, formation water is being sampled, and turbidity has reached acceptable levels or stabilized.

The following data should be recorded before and during well development:

1. Date and duration of development

2. Water level from the marked measuring point on the top of casing before and 24 hours after well development.

3. Depth from top of well casing to the top of any sediment present in the well, before, during, and after development.

4. Types and quantity of drilling fluids introduced during drilling and development.

5. Field measurements (e.g., turbidity, specific conductance, pH, dissolved oxygen, temperature) taken before, during, and after well development.

6. Volume and physical characteristics of developed water (e.g., odor, color, clarity, particulate matter).

7. Type and capacity of pump and/or bailer used and pumping rates.

8. Detailed description of all development methods used.

Glossary

Backwashing The surging effect or reversal of water flow in a well that removes fine-grained material from the formation surrounding the borehole. Only formation water is used during this process.

Jetting Bursts of high-velocity water injected into the well.

Overpumping Pumping at rates generally greater than those used during sampling or well purging. Commonly combined with surging of the well.

Surge Block A plunger-like tool, consisting of leather or rubber discs sandwiched between steel or wooden disks that may be soild or valved, that is used in well development.

Surging A well development technique where the surge block is alternately lifted and dropped within the borehole above or adjacent to the screen to create a strong inward and outward movement of the water through the well intake.

Turbidity Solids and organic matter suspended in water.

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